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EVALUATION OF BACKGROUND IONISING RADIATION LEVELS WITHIN GWAGWALADA TOWN-ABUJA

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ABSTRACT

The measurement of background ionising radiation levels within Gwagwalada Town, Abuja has been carried out using Atomtex 1117M Radiation Monitor in twelve different locations. Twenty different readings were taken at each location and the mean equivalent dose rate was used to calculate the annual equivalent dose rate. A total of 240 measurements were taken across the 12 locations in the study Area. It was observed that the average dose equivalent varied from 0.105±0.008 μSv/h to 0.114±0.015 μSv/h with a mean of 0.109±0.013 μSv/h. The mean value from Ungwan Bassa shows the highest equivalent dose rate while the equivalent dose rate from Phase 3 was the lowest. Ungwan Dodo, Ungwan Gwari recorded the second and third highest in-situ gamma radiation of 0.113±0.013 μSv/h and 0.112±0.012 μSv/h respectively. The result shows that the entire equivalent dose rates of all the locations were below the value of the Standard Background Radiation of 0.133 μSv/h. The study also revealed that the average annual equivalent dose rate is 0.192±0.005 mSv/y which is lower than the value of 1.0 mSv/yr averaged over five consecutive years according to the dose limit recommended by the International Commission on Radiological Protection (ICRP).

KEYWORDS: Ionising Radiation, Radiation Monitor, Equivalent Dose, Background Radiation, Dose Limit

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INTRODUCTION

Many forms of radiation are present in our natural environment of which some are produced by modern technology. Most of them have the potential for both beneficial and harmful effects. Even the sunlight, the most important radiation of all, can be harmful in excessive amounts. In our daily life, we are exposed to various types of naturally occurring radiation from cosmic rays, from radioactive substances in the earth, and from naturally occurring radiation from our bodies.

The progressive activity of man on the earth's surface and his unrelenting effort to satisfy his curiosity has brought about inventions, technological advancements and development in various sectors through the application of scientific knowledge and consequent generation of ionizing radiation. This has greatly contributed to the degradation of the environment, thereby exposing the public to chronic health problems. Nevertheless, these are natural and permanent features in the environment and the risk associated with them can only be reduced and not eliminated altogether (Nworgu *et al*., 2012).

In Nigeria, environmental ionizing radiation profile has not received attention as many associate the risk of exposure to radiation only from atomic bombs and nuclear power plants. The risk of exposure to radiation is often ignored with attendant grave health consequences as it has been proved, man in his everyday experience is immersed in dangerous ionizing radiations occurring naturally in human environment (Jwanbot *et al*., 2013).

The exposure of humans to ionizing radiation from countless sources around the environment is evident. Some of which are cosmic rays and natural radionuclide sources in air, food and drinking water (Oyeyinka *et al*., 2012; UNSCEAR, 2000). It has been established that natural occurring radioactive materials (NORM) constitute 85% of radiation dose to man, man-made activities constitutes about 15% (UNSCEAR, 2000). The implication of this statistics is obvious, there is the probability of increase in the ionizing radiation distribution in a given time interval, and with the increase in man's activities, it is reasonable to expect that they could also be high.

The basic difference between ionizing radiation and non-ionizing radiation is that ionizing radiation has sufficient energy to cause ionization in matter in which they pass through (Olarinoye *et al*., 2010). Monitoring radiation levels involve both in-situ and laboratory methods. The particular method to be used depends on several factors. In achieving fast estimate the in-situ method is a better way as it gives quick results (Sigalo and Briggs-kamara, 2010).

Radiation monitoring is a very important precaution against over-exposure to harmful ionizing radiation since we are inescapably exposed to environmental background radiation.

This environmental ambient radiation varies in intensity and quality from place to place and from time to time (Ndiriza *et al*., 2008).

Ionizing radiation has the ability to affect the chemical state of a material and so cause changes which are biologically important (Jwanbot *et al*., 2013). Exposure to ionizing radiation can cause injuries and clinical symptoms; which may include a chromosomal transformation, cancer induction, free radical formation, bone necrosis and radiation catractogenesis (Norman and Kagan, 2008). The injuries and clinical symptoms could be caused by both chronic and acute dose exposure. Because of the lethal effects of ionizing radiation, the practice has been to monitor and assess the levels of exposure and keep one's exposure to ionizing radiation As Low As Reasonably Achievable (ALARA Principle).

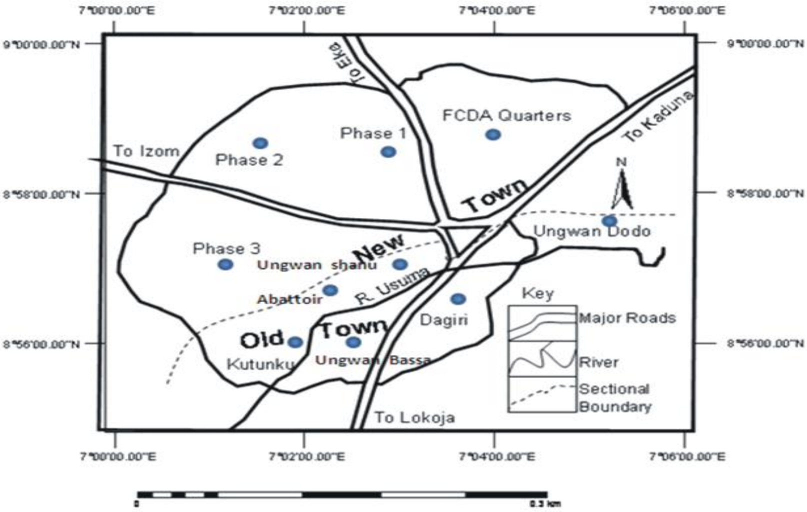

Fig 1: Gwagwalada Town

MATERIAL AND METHODS

This study concentrates on Gwagwalada town of the Federal Capital Territory of Nigeria. The town is about 45 km away from the Federal Capital City (FCC). It is one of the six Area Council headquarters of the FCT. The town lies in the downstream of River Usuma and located between latitude 8° 55´ and 9° 00´N and longitude 7° 00´ and 7° 05´E (Figure 1).The centrality of this town in relation to other Area Councils headquarters makes it influential and important in various Socio-economic activities. Climate of this town is not farfetched from that of the tropics having several climatic elements in common; most especially the wet and dry season, characteristic (Ishaya and Grace, 2007). Gwagwalada town, with an aerial extent of about 118 km², has an elevation of between 142.2 m and 213.3 m in the southern and northern parts of the town respectively. The temperature of the area ranges from 30 - 37°C yearly, with the highest temperature experienced in the month of March and with mean total rainfall of approximately 1,650 mm per annum (Balogun, 2001). About 60% of this rain falls between the months of July to September. Relative humidity range between 25% to 50% in the dry and rainy seasons respectively. This study was conducted in March, 2014.

An in-situ approach of background radiation measurement was adopted and preferred to enable samples maintain their original environmental characteristics. To adequately cover the designated survey location, twenty (20) readings were taken at different points in each of the twelve survey areas within Gwagwalada Town using a radiation monitor, Atomtex AT 1117M. The survey areas are Dagiri, Ungwan Dodo, Ungwan Shanu, Ungwan Bassa, Ungwan Aguma, Ungwan Gwari, Abattoir, Kutunku, Phase 1, Phase 2, Phase 3 and Kotangora Estates.

The Atomtex AT 1117M with serial no 14199 (manufactured by Scientific and Production Enterprise, Republic of Belarus) is a portable combined multifunction radiation monitor with digital readout, designed for measuring X-ray, gamma and neutron radiation ambient dose equivalent, density of alpha and beta radiation flux density from contaminated surfaces, alpha and beta radiation surface activity and neutron flux density.

The monitor was suspended in air at one meter above the ground level. Readings were obtained between the hours of 1200 and 1600 hours since the exposure rate meter has a maximum response to environmental radiation within these hours (Oyeyinka *et al*., 2012).

The equation below is used to calculate the annual effective dose equivalent received outdoor.

Annual Dose Equivalent (mSv/y) = Equivalent dose rate (μSv/h) × 8760 (h/y) × 0.2 (occupancy factor) × 0.001 (μSv/mSv) (Tayyeb *et al*., 2012).

RESULTS AND DISCUSSION

Data for the average equivalent dose rates of the areas measured and the annual effective dose rate are presented in Table 1. A total of 240 measurements were taken across the 12 locations in the study Area. Generally, from the result, the average equivalent dose rates for each area ranged between 0.105±0.008 μSv/h to 0.114±0.015 μSv/h. The mean value from Ungwan Bassa shows the highest equivalent dose rate while the equivalent dose rate from Phase 3 was the lowest. The total equivalent mean dose rate in all the twelve locations is 0.109±0.013 μSv/h. Ungwan Dodo and Ungwan Gwari recorded the second and third highest in-situ gamma radiation of 0.113±0.013 μSv/h and 0.112±0.012 μSv/h respectively. This result shows that the entire equivalent dose rates of all the locations were below the value of the Standard Background Radiation of 0.133 μSv/h.

Table 1: Average equivalent dose rate and annual effective dose rate of different locations measured

S/N	Location	Average Equivalent Dose Rate* (µSvh^{-1})	Annual Dose Equivalent (mSvy^{-1})
1	Dagiri	0.109±0.010	0.191
2	Ungwan Dodo	0.113±0.013	0.198
3	Ungwan Shanu	0.111±0.012	0.194
4	Ungwan Bassa	0.114±0.015	0.199
5	Ungwan Aguma	0.111±0.021	0.194
6	Ungwan Gwari	0.112±0.012	0.195
7	Abattoir	0.109±0.014	0.190
8	Kutunku	0.110±0.012	0.193
9	Phase 1	0.107±0.013	0.187
10	Phase 2	0.106±0.013	0.185
11	Phase 3	0.105±0.008	0.183
12	Kotangora Estates	0.108±0.011	0.189

**Values represented as Mean ± Standard Deviation*

Figure 2 shows the annual dose equivalent of different locations. To avoid any somatic, epidemiological and radiological health side effect, ICRP (2007a) recommended and consequently set the maximum permissible limit for non–radionuclide industrial worker and the public as 1.0 mSvy^{-1}. The results revealed that the dose levels in all of the locations were below the maximum permissible limit for the public.

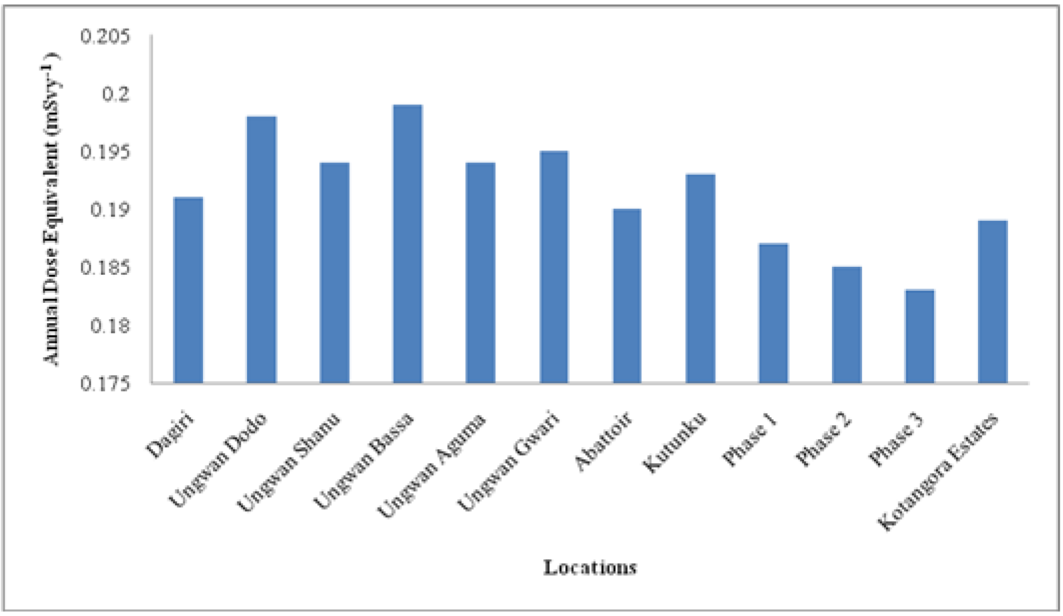

Fig 2: Annual dose rate equivalent of different locations

CONCLUSION

The environmental monitoring of radiation dose rates has been computed within Gwagwalada Town of the Federal capital Territory, Abuja using in-situ measurement method. This was meant to determine the background ionization radiation level of the study area. The study revealed a radiation level within the acceptable limit for the general public. The annual equivalent dose rate obtained for all the locations sampled did not exceed the safe limit recommended by the international bodies on radiation protection. This work revealed that the average dose equivalent varied from 0.105±0.008 μSv/h to 0.114±0.015 μSv/h with a mean of 0.109±0.013 μSv/h which is below the standard background radiation of 0.133 μSv/h. The study also revealed that the average annual equivalent dose rate is 0.192±0.005 mSv/y which is lower than the value of 1.0 mSv/y averaged over five consecutive years according to the dose limit recommended by the International Commission on Radiological Protection (ICRP, 2007a). This indicates that the people living and working within the study area are safe and are not exposed to high doses of radiation as a result of activities in the town. The results from this work will form part of the baseline data which will be useful in assessing contribution to radiation in the environment from future activities of the study area.

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